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Title: REGULATORY GUIDANCE FOR PACKAGING RADIOACTIVE SOURCES EXERCISES

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**REGULATORY GUIDANCE FOR PACKAGING RADIOACTIVE SOURCES
EXERCISES**

Jim Matzke

IAEA Nuclear Security Series No. 9

**SECURITY IN THE TRANSPORT OF
RADIOACTIVE MATERIAL**

IMPLEMENTING GUIDE

- 4.1. PRUDENT MANAGEMENT PRACTICES**
- 4.2. BASIC SECURITY LEVEL**
- 4.3. ENHANCED SECURITY LEVEL**
- 4.4. ADDITIONAL SECURITY MEASURES**

A.1. ESTABLISHING SECURITY LEVELS

- Per package: Enhanced security provisions would be applied when any package in a consignment exceeds the threshold value.**
- Per conveyance: Enhanced security provisions would be applied when the total activity on a conveyance exceeds the threshold.**

A.2. SPECIFICATION OF THE TRANSPORT SECURITY THRESHOLD

To facilitate the undertaking of the transport security measures, the following definition of ‘high consequence’ radioactive material is used; 3000 A2 in a single package, except for the following radionuclides:

Radionuclide	Transport security threshold(TBq)
Am-241	0.6
Au-198	2
Cd-109	200
Cf-252	0.2
Cm-244	0.5
Co-57	7
Co-60	0.3
Cs-137	1
Fe-55	8000
Ge-68	7
Gd-153	10
Ir-192	0.8
Ni-63	600
Pd-103	900
Pm-147	400
Po-210	0.6
Pu-238	0.6
Pu-239	0.6
Ra-226	0.4
Ru-106	3
Se-75	2
Sr-90	10
Tl-204	200
Tm-170	200
Yb-169	3

Exercise #1



You are on a recovery team that will be responsible for packaging and transporting the source shown in the photograph above.

Co-60 $A_1 = 1 \text{ TBq}$ $A_2 = 0.4 \text{ TBq}$

Question #1

With the original activity of 5210 Ci (192.77 TBq), what type of package would be required to for transport?

Question #2

With the decayed activity of 7.19 TBq, what type of package would be required to for transport?

Question #3

What transport security level would you recommend?

Exercise #2

Drum Evaluation

Background: A 10 Ci (0.37 TBq) Am-241Be special form source is to be packaged.

Am241 $A_1 = 10 \text{ TBq}$ $A_2 = 0.001 \text{ TBq}$

Question #1

What type of package would be required to for transport?

Question #2

After the source is packaged, the dose rates are:

Contact:

Gamma – 0.01 mSv/hr

Neutron – 0.20 mSv/hr

1 meter:

Gamma – 0.005 mSv/hr

Neutron – 0.02 mSv/hr

What is the Transport Index (T.I.) for this drum?

Question #3

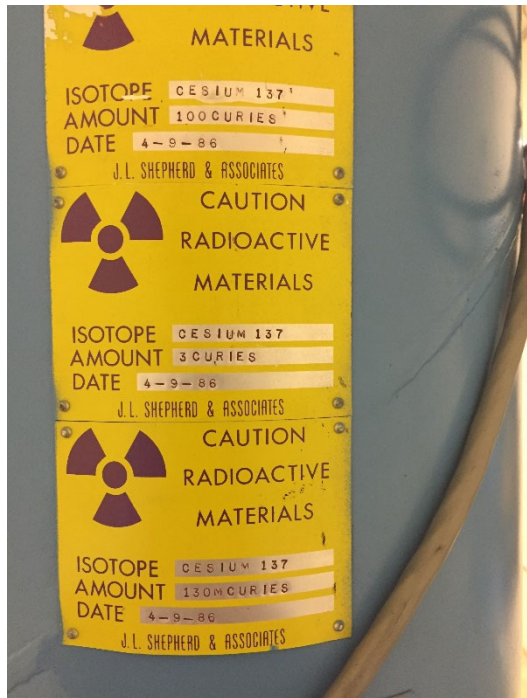
Which radioactive label (white – I, yellow – II, yellow – III) is required?

Category	Maximum radiation level on external surface	Transport Index (mSv/hr x 100)
I-White	$\leq 0.005 \text{ mSv/h}$	0 (less than 0.05)
II-YELLOW	$> 0.005 \text{ mSv/h}$ $\leq 0.5 \text{ mSv/h}$	> 0 ≤ 1
III-YELLOW	$> 0.5 \text{ mSv/h}$ $\leq 2 \text{ mSv/h}$	> 1 ≤ 10
III-YELLOW (transported as exclusive use)	$> 2 \text{ mSv/h}$ $\leq 10 \text{ mSv/h}$	> 10

Question #4

What transport security level would you recommend?

Exercise #3



You are on a recovery team that will be responsible for packaging and transporting the source shown in the photograph above.

Cs-137 $A_1 = 2.0 \text{ TBq}$ $A_2 = 0.6 \text{ TBq}$

Question #1

With the original activity of 103.13 Ci (3.816 TBq), what type of package would be required to for transport? (Special Form)

Question #2

With the decayed activity of 1.76 TBq, what type of package would be required to for transport? (Special Form)

Question #3

What transport security level would you recommend?

Exercise #4



You are on a recovery team that will be responsible for packaging and transporting the sources shown in the photograph above.

Pu-239 $A_1 = 10 \text{ TBq}$ $A_2 = 0.001 \text{ TBq}$

Question #1

Each source is 1 Ci (0.037 TBq); total is 0.111 TBq. The sources will be encapsulated to meet special form requirements. What type of package would be required for transport?

Question #2

What transport security level would you recommend?

Exercise #1 Answers

Answer #1

The original source activity is above the A_1 and $A_2 = 0.4$ TBq limit, requiring a Type B

Answer #2

The decayed source activity is above the A_1 and $A_2 = 0.4$ TBq limit, requiring a Type B

Answer #3

The source activity is above the Co-60 Transport Security Threshold of 0.3 TBq recommending a minimum – Enhanced Security Level and possibly Additional Security Measures

Exercise #2 Answers

Answer #1

The special form source activity is below the A_1 10 TBq limit, requiring a Type A

Answer #2

T.I. = Total dose rate at 1 meter in mSv/hr x 100

a. 1 meter:

Gamma – 0.005 mSv/hr

Neutron – 0.02 mSv/hr

Total = 0.025

TI = 2.5

Answer #3

Yellow - III

Answer #4

The source activity is below the Am-241 Transport Security Threshold of 0.6 TBq recommending a minimum – Basic Security Level

Exercise #3 Answers

Answer #1

The original source activity is above the A_1 2.0 TBq limit, requiring a Type B

Answer #2

The decayed source activity is below the A_1 2.0 TBq limit, requiring a Type A

Answer #3

The source activity is above the Cs-137 Transport Security Threshold of 1 TBq recommending a minimum – Enhanced Security Level

Exercise #4 Answers

Answer #1

Pu-239 is a fissile material and the quantity of material does not meet any exception. The total activity is below the $A_1 = 10$ TBq, therefore a Type A Fissile (AF) container is required

Answer #2

The source activity is below the Pu-239 Transport Security Threshold of 0.6 TBq recommending a minimum – Basic Security Level